Under-Armor Auxiliary Power Unit (APU) For the M1A2

by Lieutenant Colonel Peter Borosky

Under Armor APU Cutaway View

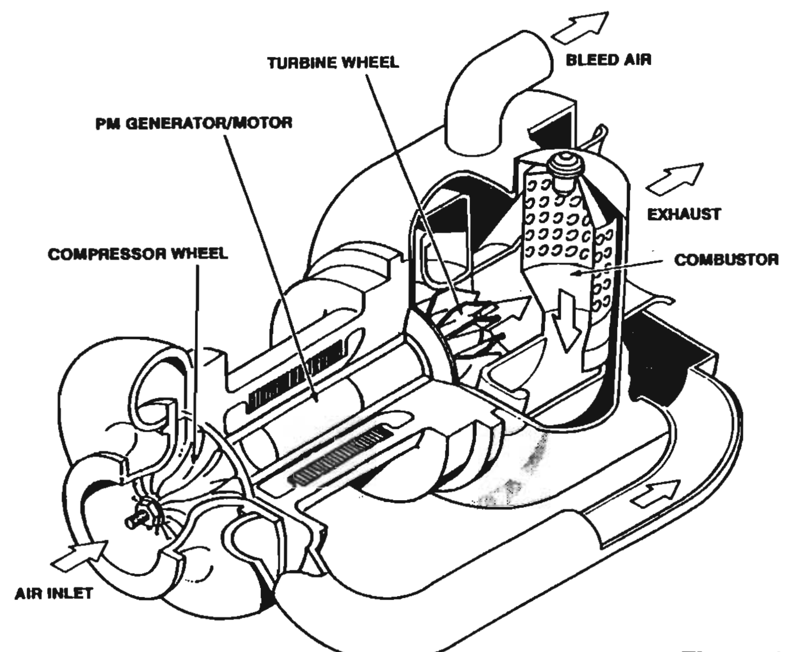


Figure 1

In recent months, interest in an auxiliary power unit (APU) for the M1A2 has gathered momentum. An APU provides tank auxiliary power and true battlefield silent watch capability while reducing costs through decreased fuel consumption, less frequent engine overhauls, and increased electrical component life.

The dilemma is to provide silent watch and not be dependent upon lead-acid batteries (L/A). The answer is an auxiliary power unit.

The silent watch requirement is at least one hour. Silent watch requirements for the M1-series tank are sights operational (CITV-M1A2), radios on listening silence, heater on (if required), turret and gun tube traversing and elevating as required, and NBC system on. Except for NBC capability, this requirement on the M1A2 is limited to the capacity or power available in the six lead-acid batteries.

Fully charged batteries on a M1A2 will provide approximately 20 minutes of silent watch before the batteries lose their ability to start the AGT 1500 engine (12.5 amp hours). The Under-Armor Auxiliary Power Unit (UAAPU) is a virtual requirement for the M1A2 based on the power requirements of its software-based architecture. This silent watch capability does not include NBC operation, which requires bleed air. Bleed air is also necessary to provide cooling to crew vests.

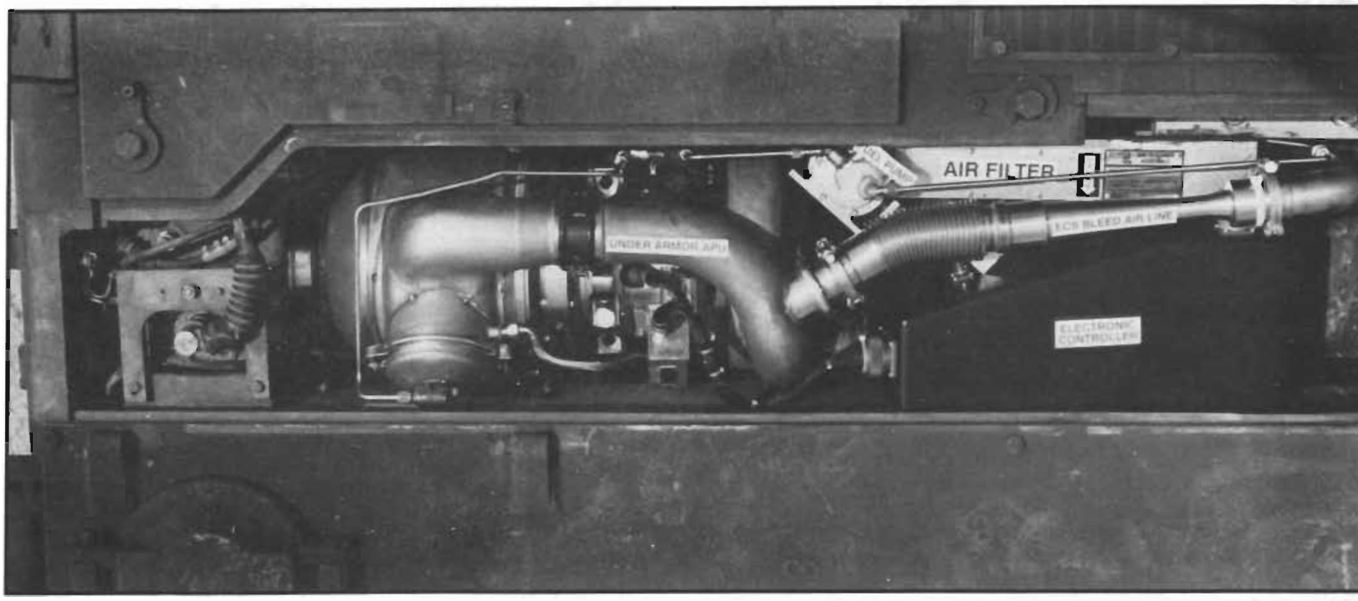
The M1A1, while not as electrically dependent as the M1A2, must be started after 45-60 minutes of silent watch to prevent L/A batteries from discharging to the point where the engine cannot be started.

Silent watch, at this point, is dependent upon L/A batteries. Army experience with L/A batteries has not been favorable. It should be noted that the charge available in L/A batteries is primarily dependent upon life of the batteries, their state of charge, and temperature. At 80 degrees F, an L/A battery has 100 percent power available with 100 percent power required to start an engine. At 32 degrees F, a L/A battery has 85 percent power available with 165 percent required. At 0 degrees F, 65 percent power available with 250 percent required.

In addressing the APU, we need to distinguish between two types. One APU is a standard APU or generator which has conventional components such as starter, gearbox, combustor, and oil lubrication. Normally, these APUs are dependent upon their size for output. Generally, more components require more maintenance.

The Army is currently buying a 2.2kw APU (conventional) for the M1A1. This APU will be mounted in the bustle rack and requires pull start, separate fuel supply, and L/A battery. The Army has bought 1,700 of these units for the M1A1 and USMC. This APU has been under development for a number of years and should double silent watch capability — but cannot run the NBC system or provide increased cooling. The technology is similar to the fender-mounted APU. This article will not address the pros and cons of this system.

The Armor Center, under the command of MG Paul E. Funk, is taking great interest in the turbine APU technology. This APU is produced by a number of companies and contains no gearbox, separate starter, or generator, which equates to far less maintenance for those components which typically cause problems (generator, gearbox).



A turbine APU is smaller, lighter, cleaner, and can provide bleed air to run the NBC system during silent watch (Figure 1).

Additionally, this system provides many advantages:

- •True silent watch capability (NBC system).
- •10-20kw output.
- •Increased cooling in vests (increase of 9,000 BTU/Hr).
- •Under armor capability (Figure 2) in battery box.

Since the APU reduces power requirements for engine start (.7 Amp/Hr), the number of batteries required is reduced (Figure 3). This system would provide tremendous capability and savings. The UAAPU would be fueled by the tank's own fuel system at 50-75 percent less fuel consumption at engine idle, producing major cost savings in engine overhaul and electrical engine components (increases mean time between failures). Cold weather start capability would be greatly increased. In fact, the system could provide full fightability with the engine removed and provide an alternate start capability for the engine. (Turbines can be started with forced air.) Other benefits would be increased battery life and a capability for self-cleaning air filters.

Another capability of this UAAPU system is that it can be coupled with Nickel-Cadmium (NICAD) batteries. New technology in this field has developed **sealed** NICADs which are advantageous since they provide the following:

- •Completely sealed in metal.
- •Completely safe — no venting/no hazardous waste.
- •No memory.
- •No recycling.
- •Maintenance free.
- •Life expectancy 10-20 years.
- •Unaffected by heat/cold.

The Aviation Center has put these sealed NICADs on their helicopter training fleet with great success and cost savings.

Sealed NICAD advantages over L/A are obvious and would be greatly appreciated by tank crews frustrated with L/A battery maintenance and handling. Unfortunately, Vietnam-era experience with NICADs has clouded the materiel developers' desire to evaluate this system.

The up-front costs to this system are high — but when analyzed over 10 years, the costs are significant for the NICAD battery and the APU (Figure 4). Savings over 10 years equate to

Proposed APU Location

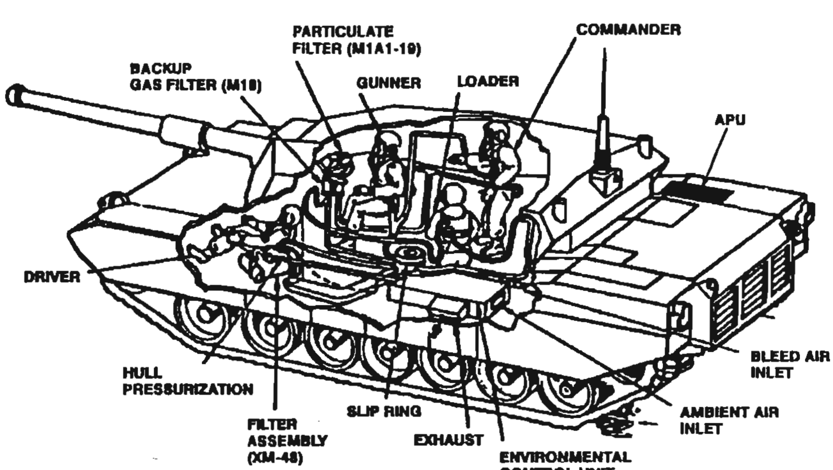


Figure 2

$6.8 million per tank battalion. These cost savings are conservative and do not include savings on battery maintenance, longer engine component life, hazardous waste (sulfuric acid), etc. This system, APU and/or NICAD, is an initiative which pays for itself.

Will the materiel developers put this system on the M1A2? The Armor Center is firmly behind this system and is preparing to install this system in an M1A1/A2 to demonstrate its worth. Integration seems to be extremely simple and could probably be installed with a modification work order bypassing expensive integration on the tank production line. This action at Fort Knox will be tested under the Mounted Warfighting Battle Space Lab.

The UAAPU is a necessity for the M1A2 and Block III tank. In summation, the UAAPU:

- Increases mission readiness.
- Increases crew/turret cooling.
- Provides tactical advantages of unlimited silent watch from noise discipline point of view.
- Satisfies the need for greater electrical output: POSNAV, IVIS, CITV, software requirements.
- Increases the fuel savings effect on operations: wasted time/fuel preparing for on-order missions such as counterattacks, limited visibility.
- Is a system that pays for itself.

It is time to get serious and go forward with a truly tactical, fully integrated under-armor APU. Bolt-on, quasi-tactical, low output APUs are not crew friendly. We need to provide a system that will enhance mission capability/readiness and decrease maintenance requirements. The Under-Armor APU is the solution for the future.

Right Rear Sponson Layout

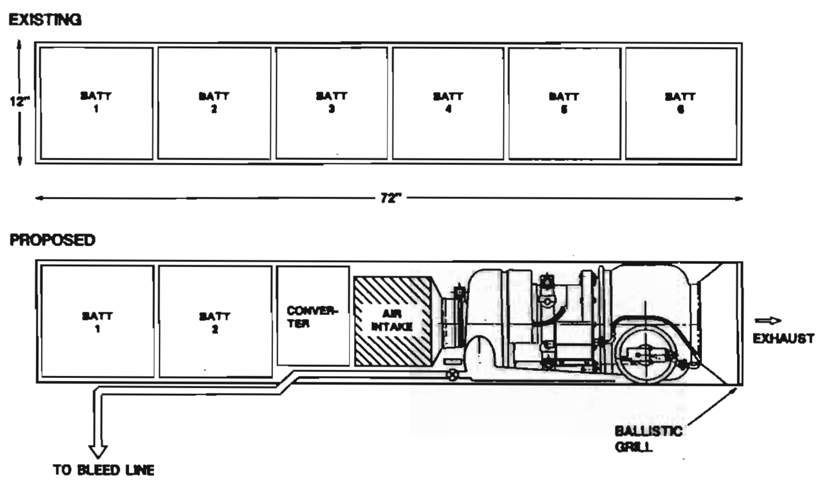


Figure 3

Cost Benefit Analysis

(NICAD)

Initial	Lead Acid	NICAD	Difference
Per Tank	$330 (6 ea @ $55)	$1,900 (2 ea @ $950)	+$1,570
Per Tk Bn	$19,140	$110,200	+$91,000
10 Yr Usage*	$1.15 MIL	$110,200	-$1 MIL

*Based on NTC Usage (60 days per lead acid battery).

(APU)

Initial Cost Per Tank - $50K

Per Tank Battalion - $2.9 MIL

POL Savings Tk Bn (10 Years) - $.5 MIL

Maintenance/Engine Savings Tk Bn (10 Years) - $5.3 MIL

*Does not include life cycle costs.

Figure 4

Lieutenant Colonel Peter H. Borosky was commissioned in Armor in 1973 from Infantry OCS. A graduate of AOB, AOAC, CAS[3], and CGSC (resident), he has served in command and staff positions in Germany and CONUS. He recently served as Chief, Combat Services Support Division (4/16 Cavalry Regiment), Fort Knox, Ky. He has a Bachelor of Science Degree in Management from Stonehill College and an MBA from Embry-Riddle University.